The faces of the form 0 0 1 are large and bright; those of all the other forms are extremely narrow, and are usually uneven.

Cleavage 0 0 1, very perfect.

No other forms of crystals than those just described were observed in any of the alloys experimented with.

The largest and best-defined crystals were obtained from the alloys containing about 41 per cent. of gold. The plates were sometimes, when crystallized from 300 grms., about 30 millims. long and 15 millims. wide, being the height and depth of the alloy in the crucible; they were generally of a bronze colour, proceeding from a slight oxidation of the tin: their true colour was that of tin. All the alloys emit a grating sound when cut through, as tin does, and are all exceedingly brittle.

From the above experiments it appears, first, that the well-defined crystals are not limited to one definite proportion of the constituents of the alloy, but are common to all gold-tin alloys containing from 43 to 27·4 per cent. gold; secondly, that crystals and mother-liquor are never of the same composition. These facts coincide with those found by Cooke* in his research on tin and antimony alloys, who observed that zinc and antimony are capable of uniting and producing definite crystalline forms in other proportions than those of their chemical equivalents.

X. "On the Sensory, Motory, and Vaso-Motory Symptoms resulting from the Refrigeration of the Ulnar Nerve." By Augustus Waller, M.D., F.R.S. Received September 3, 1861.

In a brief account of the effects of compression of the human vagus and sympathetic nerves†, I mentioned as one of the symptoms produced, "a tingling and heat of the ear corresponding to the side compressed, often lasting upwards of half an hour after removal of the pressure."

The sensations thus experienced are frequently of a hot, mordicant character, as if arising from the passage of a hot fluid through the vessels, extending progressively and causing a flush over the surface

* Silliman's American Journal, (2) vol. xx. p. 222.

† Proceedings of the Royal Society, No. 44, page 302.

of the lower part of the ear. The feelings in fact resemble those experienced in ordinary cases of blushing.

In my observations on compression of the vago-sympathetic, I found that the above-mentioned auricular symptoms are more uncertain than those affecting the organs controlled by the vagus. Thus in the same individual where six observations were made successively at about an interval of an hour between each, dyspnœa, irregularity of the heart's action, and uneasiness of the stomach were produced on each occasion, while the ear-symptoms were obtained twice out of the six, and lasted but a few minutes after removal of the pressure.

On the other hand, sometimes the auricular symptoms predominate, whilst the others are scarcely perceptible.

Although the auricular symptoms are certainly due to the influence of some branch of nerve, we find considerable difficulty when we endeavour to ascertain the exact branch that is affected, as besides the vascular branches of the cervical sympathetic which exist over the part compressed, we have also the auricular branches of the cervical plexus close by, which may likewise give rise to the symptoms in question, either by their direct influence or by reflex action.

For many reasons, which I will not enter upon at present, I have come to the conclusion that most, if not all of the symptoms produced by compression of the vagus are the result of reflex action in all the nerves governing the organs affected, viz. heart, lungs, stomach, &c. I have arrived at the same conclusion respecting the mode of production of the auricular symptoms, viz. that they are reflex. As the complex arrangement of the nerves in the neck prevented my obtaining any precise knowledge of the nerve acted upon, I was led to make a careful study of the effects of various agents on those nerves which are more accessible to examination, in order to ascertain how far the spinal nerves distributed to other parts are susceptible of giving rise to the same symptoms as those experienced in the ear.

My present experiments have been made chiefly on the ulnar and internal popliteal nerves, but it is not my intention on this occasion to describe them in detail; I shall accordingly state only the leading results, and for the present shall confine myself to those obtained with the ulnar nerve.

I have generally made use of refrigerating agents, such as ice and water at 0° Cent. The symptoms produced by either of these applications relate to—1st, the sensibility; 2nd, the excitability; 3rd, the temperature of the nerve under examination, or of the parts which it supplies.

Sensory symptoms.—The first effect of the application of ice to the ulnar nerve, as is well known, is a state of hyperæsthesia descending apparently to the inner fingers, which gradually increases until it becomes very painful. After a minute or two the hyperæsthesia diminishes, and the pain suddenly disappears.

Sometimes the nerve passes from this condition into a state of complete anæsthesia, when both the nerve and the integuments below are insensible.

In other cases, before these parts are rendered insensible, we have hyperæsthesia and analgesia of the nerve recurring several times before the supervention of the stage of anæsthesia.

Symptoms of motricity.—The first change in the excitability of the nerve, or its power of inducing muscular contractions, is that of increased action on either mechanical or electrical irritation, and is so manifest, that an ordinary degree of irritation, which in the normal state will scarcely produce any muscular contraction, will cause strong movements of the wrist and fore-arm.

The second stage of nerve-excitability is that in which there is decreased muscular action terminating in its complete loss.

The passage from the first to the second stage is marked by no distinct symptom, as the one gradually blends into the other. While the nerve is passing through these stages, the muscles subject to the nerve likewise present changes. At the inner part of the fore-arm they slightly contract, and the little and ring-fingers particularly become somewhat flexed and stiff, and their movements imperfect. Finally, these muscular parts become quite paralysed, and the little finger remains permanently flexed.

Temperature.—For the purpose of measuring accurately the temperature of the parts supplied by the nerve during the various changes in its condition, very delicate instruments are indispensable. I have used for the present experiments two standard thermometers of M. Geissler of Bonn, in which, although the reservoir is very small, the tenth part of a degree Centigrade is easily read off by the naked eye.

It is almost unnecessary to state that, in measuring the changes of temperature taking place in different parts of an organ such as the hand, two points as nearly homologous as possible in temperature must be chosen. On the hand the intervals between the index and middle finger and that between the annular and little finger are found to present as nearly as possible the same temperature in the normal state.

As thermometric measurements admit of far greater accuracy of expression than those relating to sensibility and muscular action, but at the same time any general or average results require to be founded on a much greater number of observations to be entitled to value, I have thought it preferable, until such have been obtained, to state the numerical thermometric results of a few separate observations.

Observation 1*st.*

Temperature of room	19° Cent.
,, of mouth	36
,, of palm of hand when shut (before experiment)	35·7
Temperature between index and median fingers	35·7
,, ,, annular and little fingers of both hands	35·7

After the uncovering of the arm, and the application of ice to the right elbow :—

Right Hand.

Temperature between last fingers	32·2
,, ,, index and median	32·7

Left Hand.

Temperature between last fingers	34·3
,, ,, index and median	34·0

After the lapse of nearly an hour, when the little finger had become nearly paralysed and insensible, the temperature was found to be—

Between last fingers of right hand	34·7
,, ,, left hand	34·7

From this point, as the paralysis gradually became complete, the temperature over the hypothenar eminence, the inner side of the

hand, and the two last fingers became gradually more elevated until it reached 36° Centigrade. At the same time the temperature of the fingers and outside of the hand became lower, at length reaching 28° Cent., where it became stationary. At this time the inner part of the hand presented symptoms of active congestion of blood, being red, and very hot to the touch, and the pulse strong,—symptoms the more evident, by comparison with the outer fingers of the same hand, where the temperature was so much lower, and the pulse weak.

After the removal of the ice from the nerve, sensibility and movement returned into the little finger, &c. in a few minutes without the supervention of any hyperæsthesia.

The restoration of the normal temperature was, however, much more gradual, giving the following results:—

Time after removal of ice. Minutes.	Temperature between last fingers. ° Cent.	Temperature between index and median. °
10	33·0	29·0
15	31·0	28·5
17	30·5	28·5
20	29·8	27·5
30	28·8	27·3
40	28·1	27·0
45	27·7	27·0
55	26·8	27·3

Temperature of skin at the internal and external surface of fore-arm at its lower fourth	30
Temperature of mouth	36
„ left hand between last fingers	27·7

The preceding observations show that considerable advantages may be derived from *refrigeration* in physiological investigation on man of the functions of the superficial nerves.

The following are the principal results:—

1. The first effect of the application of cold to the ulnar nerve on its sensory function is a state of hyperæsthesia in the course of the nerve.

2. This hyperæsthesia is succeeded by a state of quiescence or freedom from pain, which is followed by anæsthesia.

3. The first effect on the motory functions of the nerve is that of increased excitability.

4. This increase in its turn subsides, until all the parts below the refrigerated portion of the nerve are paralysed, owing to the interruption of its conductivity.

5. In this paralytic condition the muscles remain contracted to a certain extent, and the inner fingers in a state of flexion.

6. The first thermal effect of cold on the nerve is frequently a fall of temperature of 0°·5 Centigrade at the inner fingers below that of the outer fingers.

7. As the nerve becomes paralysed, the temperature of the two inner fingers rises above that of the outer to the extent of 5° or 6° Cent. This is owing to the paralysis of the vascular nerves and vessels of the parts supplied by the ulnar nerve, and is of the same nature as that in the ear after section of the sympathetic nerve, where, as I have demonstrated, the temperature may be lowered or increased at will by acting on the nerve by galvanism.

8. In my experiments on the sympathetic*, I have observed an increase of 10° Cent. on the side operated on over that of the sound side. In the above observations on man the increase at the inner fingers was = 5° Cent.; and it is probable that in cold weather a much greater difference will be found in the temperature of the two sides, because as the range is between blood-heat, which is the maximum, and the temperature of the part before the experiment, the extent of the range is much greater in cold weather than in the present month of August.

9. While the temperature of the inner part of the hand is rising, that of the outer decreases, on account of the diversion of part of the blood of the radial into the ulnar artery. The same effect is witnessed after section of the sympathetic, where a fall of temperature of the sound ear coincides with elevation of temperature in the opposite ear.

10. After the removal of the refrigerating body, the nerve quickly regains all its original powers, except that the normal equilibrium of temperature of the two sides of the hand is but slowly restored. It is probable that this is to be attributed to the slowness of contraction of the organic muscular fibres of the ulnar artery.

* *Vide* Comptes Rendus de l'Acad. de Sciences, February 1853.